unsuccessful attempts had been made to lay it—and in the following year, some months after it had been recovered and completed, both it and the new 1866 cable broke, while one of them broke again the following year.

The fact is that to construct an Atlantic cable at all in those days was a very courageous thing to do; to lay it successfully, even with many failures, evinced a faith and confidence in engineering skill and a dogged spirit of determination that make one proud of the Anglo-Saxon race. To every one who took a prominent part in the enterprise, as certainly did Sir Charles Bright, all honour is due as well as the thanks, not only of his contemporaries, but of all who have followed him.

But we are inclined to think that the authors of this memoir would have been well advised had they not allowed their reverential memory for the brother of the one and the father of the other to lead them to adopt the painter's only method of representing a bright light, viz. by intentionally throwing the rest of the picture into shade.

Volume ii. deals with the telegraph to India, Sir Charles' parliamentary life, the West Indian cables, Sir Charles' work in connection with mining, fire alarms, telephony, electric lighting, the Paris Electrical Exhibition of 1881, the Institution of Electrical Engineers, Freemasonry, and concludes with various appendices.

This life-story is distinctly interesting, but its interest would have been even greater had the matter been compressed into about half, or at any rate into not more than two-thirds, the space. Before a second edition appears we would suggest that such scientific crudities as the following should be altered :—"A current which was estimated by the experts to amount to about 2000 volts." "In the absence of a determinate unit of inductive capacity or quantity of electricity condensers were employed for the first time." "When electricity passes through this surrounding coil of wire, the magnet and mirror take up a position of equilibrium between the elastic force of the silk and the deflecting force of the current. . . . The magnet is artificially brought back to zero with great precision after each signal by the use of an adjustable controlling magnet."

OUR BOOK SHELF.

The Maintenance of Solar Energy. By F.R.A.S. Pp. 20. (London: The Southern Publishing Co., Ltd., 1899.)

THE author of this short essay is not satisfied with the current ideas as to the maintenance of solar energy, but believes his new views tend to remove much of the difficulty. So far as can be judged by these "preliminary notes," however, the theory advanced is one which is not likely to convince any one but its author. Interplanetary water vapour and the periodical indulgence of the sun in cometary vapour baths appear to play an important part, the idea being that as a result of their action the radiant forces of the sun are confined within the limits of the solar system. The recurring absorption of the planets by the sun and subsequent disruption into new systems are other features of a theory which has its principal strength in the fact that there are no means of testing its chief teachings. The author's name does not appear on the title-page, but the preface is signed by J. H. Brown.

Official Report of the National Poultry Conference held at Reading in July 1899. Edited by the Honorary Secretaries, Edward Brown, F.L.S., and F. H. Wright, F.S.A.A. Pp. xvi + 138.

THE conference of which this is a report was the first of its kind held in this country, and its success should lead to other similar meetings. The report shows that most of the papers were of a scientific character, and its publication should extend the knowledge of the principles which lead to successful poultry-farming. Among the subjects dealt with are: the science and practice of farm poultry keeping, the parasitic diseases of poultry, and the assistance afforded by science in the production of eggs and poultry. There will be hope for British agriculture when the spirit which pervades these papers guides the operations of all who are concerned with rural industries.

The Story of Ice in the Present and Past. By W. A. Brend. Pp. 228. (London: George Newnes, Ltd., 1899.)

AN instructive addition to the "Library of Useful Stories," containing a clearly-written account of the physical properties and geological operations of ice. General readers should find the volume interesting. We notice that the cavities formed by glacier mills are termed "potholes or giant's kettles"; but the former term ought to be restricted to the circular holes found in the beds of streams.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Effect of Vibration on a Level Bubble.

I HAVE never seen any notice of this phenomenon, but it is sufficiently curious to be worth describing.

I had fitted on a bicycle a small level with a radius of curvature of a foot, in order to note gradients without dismounting. In general this answered very well, and the gradients could be satisfactorily measured with an accuracy of about 1 per cent., but when going over certain classes of rough road (*e.g.* granite paving), the roughnesses of which had a definite pitch, it was noticed that though the road might be level, the bubble would at certain speeds indicate gradients as steep as one in eight or one in six, and remain steadily in such positions as long as the speed and character of the road remained constant. It seemed a matter of chance whether the bubble moved so as to indicate an up or a down gradient.

The explanation is to be found in the coincidence of a natural period of the bubble, due to the surface tension of the fluid, and the interval which elapses between successive encounters of the bicycle wheel with the roughnesses of the road.

Owing to the level being at a certain height above the ground (it was attached to the upper tube of the frame), any pitching of the bicycle, such as is caused by going over rough ground, gives a backward and forward motion to the frame in addition to the general onward movement.

We may suppose, for the sake of simplicity, that this backward and forward motion is a simple harmonic.

When a level is subjected to a harmonic displacement parallel to the mean direction of the tube, the bubble will endeavour at each instant to place itself at that part of the tube where the tangent is at right angles to the resultant of gravity and the imposed acceleration. Thus the bubble tends to move relatively to the tube in the direction of the displacement of the latter, and would always occupy its true position with regard to the resultant if its motion under the variable force was quick enough. The motion of the bubble, however, is very slow compared with that required to bring about this result; but although the forces which act on the bubble have not time to move it far in each period, they do deform it, and the deformation may become

large if the imposed force has the same frequency as any of the natural vibrations of the bubble.

When the bubble is long, as in an ordinary level, the result when such a coincidence is reached is that the long bubble is broken up into a number of small ones, but in the bicycle level the bubble was small and nearly spherical.

The slowest natural vibration which a spherical bubble is capable of is that in which it becomes alternately a prolate and oblate spheroid.

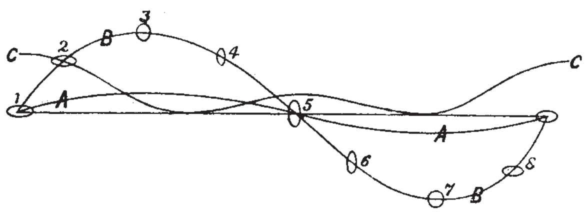
It would take too long to enter in detail into the character of the deforming forces acting on the bubble. They are of two kinds, one depending on the acceleration and the other on the velocity. The former tends to make the bubble egg-shaped (*i.e.* big at one end and small at the other) to a degree proportionate to the acceleration; the latter involves the ratio of the cross section of the bubble and tube, and tends to make the bubble oblate as the velocity increases.

When the impressed motion has the same period as the bubble, the latter will pass through its zero position in opposite phases. Thus, if in moving forwards it is an oblate spheroid as it passes through the zero, it will be prolate half a period later when returning backwards through the same position, but both the deforming force and resistance to motion through the fluid which the bubble experiences when prolate are less than when it is oblate, so that there is a balance in favour of the oblate deformation, which will tend to increase and perpetuate a vibration once started.

Since the resistance experienced by the prolate form is less than oblate resistance, the excursion of the bubble will be greater in the first case than the last, with the result that in time it will move to such a position that the slope of the tube there supplies a force sufficient to balance the difference of resistance met with in moving in opposite directions.

In the accompanying diagram the direction of the level tube is supposed to be at right angles to the abscissa axis, which represents the time of one oscillation.

AA displacement of level tube; BB displacement of bubble relatively to the tube; CC deforming force depending on the



velocity; 1, 2, 3, &c., the forms assumed by the bubble at various phases.

There is some particular ratio between the diameters of the bubble and tube, and some absolute diameter of the tube, depending on the surface tension and density of the fluid, which gives the maximum displacement, but even an approximate analytical solution of the problem would present great difficulties.

In the level experimented on, the surface tension of the fluid employed was 27 (in C.G.S.) and density ·88.

The radius of the bubble was ·142 cm. and that of the tube ·23 cm. (rough measurements).

A spherical bubble of the radius given if surrounded by an unlimited quantity of fluid of this surface tension and density would have for the frequency of its slowest natural vibration 120 per second nearly (see Lamb, "Hydrodynamics," p. 463), but in the case under consideration the small distance between the sides of the bubble and tube must greatly diminish the frequency of this form of vibration.

By experiment it was found that the greatest displacement occurred with a frequency between 40 and 50 per second, the bubble then being driven to the ends of the tube where the slope was about one in five.

A. MALLOCK.

3, Victoria Street, October 3.

Rural Education.

THE Countess of Warwick and Prof. Meldola are entitled to all praise for their zeal in establishing the School of Science at Bigods, to which reference was made in your issue of October 5. There should, however, be some recognition of the similar work done by others in purely rural districts. At Bruton, a village in Somersetshire, the success of such a school has been quite phenomenal. Sexey's Trade School, as it is called, owes its inception to Mr. Henry Hobhouse, M.P., and was founded a few years ago out of the old endowments of Sexey's Hospital under a scheme of the Charity Commissioners, with aid from the Somerset County Council. Recently I had an opportunity of seeing the school, and could not sufficiently admire the excellence of what is done there. The buildings consist of a master's house, large schoolroom and lecture-rooms, well-equipped physics and chemical laboratories, wood and metal workshops, gymnasium, &c., with about two and a half acres of garden and playground attached. Besides instruction in the ordinary subjects of a higher primary or secondary school, the boys in the upper division (Classes II. to V.) are taught magnetism, electricity, chemistry, mechanics, manual work in cardboard, wood and metal, mensuration, French, botany and bookkeeping, and the instruction in technical subjects is throughout of a *practical* nature, being given in the garden, field, and workshops, as well as in the class-room. Outdoor lessons are given in land measuring. Visits are occasionally paid to farms in the neighbourhood to inspect the stock, implements, buildings and crops. Botanical walks are taken at intervals in order to study plants in their natural habits, and the boys are encouraged to make collections of botanical and other specimens.

Since 1896 the school has been organised as a School of Science, and through the courtesy of the headmaster, Mr. Knight, I am able to place the following details before your readers. The fees for tuition are 4*l.* and for boarding 20*l.* per annum. The school has been accepted by the Somerset and Wilts County Councils as one of those at which junior and intermediate county scholars may attend. There are 103 boys at the school, of whom 25 are the sons of farmers, 20 of artizans, and 32 of small tradesmen. Of those who have left the school 34 have taken to farming as an occupation. From the forty-fifth Report of the Science and Art Department it appears that in 1897 the school presented 63 pupils for examination. The grant earned was 384*l.*, being an average of 6*l.* 2*s.* per head. The High School at Middlesbrough stood next on the list with an average of 5*l.* 13*s.* per head, and the general average for the 143 organised Science Schools in Great Britain was 3*l.* 9*s.* 6*d.* Such an experience as this ought to be of the greatest encouragement to those who are really anxious for the improvement of rural education, and the facts cannot be too widely known. This school differs from the one at Bigods in that it is only for boys; but a school is now being erected in the immediate neighbourhood to provide a modern education for girls, corresponding as far as possible with that provided for the boys.

JOHN C. MEDD.

Stratton, near Cirencester, October 15.

THE good work being done at Sexey's Trade School is of course well known to all who have interested themselves in rural education. Readers of NATURE will no doubt be glad to have Mr. Medd's independent testimony, and more particularly the detailed statement of figures concerning grants and fees. At the present time, when the subject of rural education is so very much before the public, it would, however, be of the greatest assistance to those who are engaged in carrying on this work if Mr. Medd could supply more detailed information concerning the aid which the County Council has given and how this assistance has been rendered; whether in the form of grants for building and equipment or for maintenance of staff, or both. Also what proportion of the initial cost of foundation as a School of Science was contributed by the Somersetshire County Council? In the present state of rural education one cannot help feeling that the whole future success of these schools is very largely dependent on the constitution of the Technical Instruction Committees of the County Councils—especially in those cases where the County Council has become recognised as the central authority. Any information, therefore, that can be given on these administrative points, either with respect to Sexey's or any similarly constituted school, would be most opportune. In the case of our school at Bigods, the initial cost of foundation and conversion into a School of Science has been mainly borne by Lady Warwick. The Essex County Council, as regards maintenance of staff, have put us on the same footing as the endowed schools in the county by granting 100*l.* annually.

R. MELDOLA.